IN THE SPECIFICATION

In the Summary of the Invention:

(Currently amended):

This objective is achieved by methods according to claims 1 and 8 and an apparatus according to claim ~~10~~ 14. Preferred embodiments are subject of the dependent claims.

The method according to the present invention allows the determination of the contour of substantially planar workpieces and comprises the following steps:

a) preparing the workpiece and possibly the workpiece support by applying a plurality of length scales and/or position-markers that are spread out over the surface of the workpiece and/or its support;

b) taking at least two overlapping photographs of the prepared workpiece from various perspectives with a digital camera;

c) photogrammetrical processing of the photographs with a data processing unit for producing a true-to-scale overall image of the workpiece, and

d) determining the contour of the workpiece from the true-to-scale overall image produced in step c).

The cited method relies on the use of a digital camera for data acquisition and the use of photogrammetry for the processing of these data. For the preferred application of this method, in which the workpieces are metal blanks for cars, considerable savings in time and material can be achieved by

- time savings for digitization of hand optimized blank contours, and

- improved blank nesting.

The underground of the workpiece during the taking of the photos is preferably dark (or even black) in comparison to the workpiece. This guarantees a high contrast between background and workpiece and helps to determine the contour.

In order to increase contrast between background and workpiece and to avoid impairing reflections, the workpiece may be coated with a contrasting layer before taking the photos. The workpiece may e.g. be sprayed with a matt paint.

The position-markers and rulers that are arranged on the support of the workpiece during the photography are preferably disposed on equalizing or compensation layers having a thickness corresponding to the thickness of the workpiece. Thus, they are in the same vertical height as the markers and rulers on the workpiece, which allows a more precise determination and reproduction of their position and measures in the photos. Moreover, weights may be positioned on the workpiece in order to press it flat on the ground.

According to a preferred embodiment of the invention, at least two photos of a workpiece are taken from perspectives that are substantially orthogonal to each other. Such photographs allow for a most precise reproduction of measures and positions of the workpiece during photogrammetry.

The photos of the workpiece may be rectified. This means that the image plane and the workpiece plane are transformed onto each other. After rectification, the different single photos can readily be combined to form a complete picture of the whole workpiece.

The contour that is determined as a result of the proposed method is preferably defined as a polygon. Such a polygon requires a minimal amount of data and at the same time allows the approximation of a real shape with any desired precision.

Moreover, the invention concerns a method of establishing a form die for cutting out sheet metal parts, wherein in a plurality of respective steps:

- a prototype of the form die is produced,

- a test sheet is cut out with the prototype,

- the contour of the test sheet is determined and compared to a reference contour, and

- the shape of the next prototype of the form die is adjusted on the basis of the comparison

The method is characterized in that the contour of the test sheet is determined with a method described above.

Due to the easy and rapid acquisition of the contour of the blanks during this method, the considerable savings of time and material mentioned above can be achieved.

The invention also comprises an apparatus for the determination of the contour of the blanks during this method, the considerable savings of time and material mentioned above can be achieved.

The invention also comprises an apparatus for the determination of the contour of workpieces in a method explained above. With such an apparatus, the advantages of the method can be realized. The apparatus comprises:

- position-markers and length scales for application to the workpiece and/or the workpiece support;

- a digital camera for recording digital, electronically stored photographs of the workpiece; and

- a data processing unit which is adapted for photogrammetrical processing of photographs of a workpiece recorded with the digital camera, for producing a true-to-scale overall image of the workpiece therefrom and for determining the contour of the workpiece from the true-to-scale overall image.